

HW 1 Solutions

Q1) Writing KVL equations at each mesh, we have

$$5i_1 + 7(i_1 - i_3) + 31 = 0$$

$$11(i_2 - i_3) + 3i_2 - 31 = 0$$

$$i_3 + 11(i_3 - i_2) + 7(i_3 - i_1) = 0$$

$$12i_1 - 7i_3 = -31$$

$$14i_2 - 11i_3 = 31$$

$$-7i_1 - 11i_2 + 19i_3 = 0$$

} solve for i_1, i_2, i_3

$$i_1 = -2 \text{ A}$$

$$i_2 = 3 \text{ A}$$

$$i_3 = 1 \text{ A}$$

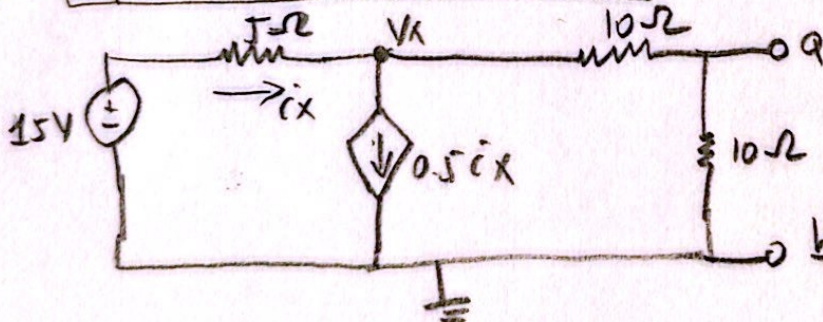
answer: 2

power delivered

by the source

$$P = -31(i_1 - i_2) = \boxed{155 \text{ W}}$$

Q2) Open circuit condition:



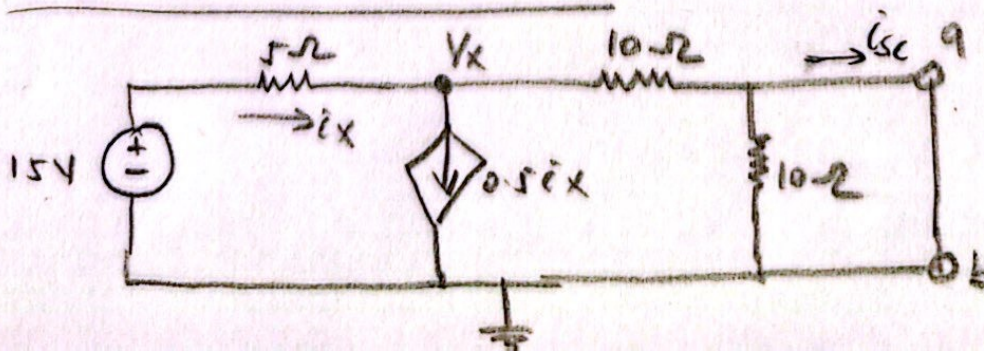
$$i_x = \frac{15 - V_x}{5}$$

$$\frac{V_x}{10 + 10} - i_x + 0.5i_x = 0$$

$V_x = 10 \text{ V}$ and then we

have $V_f = V_{oc} = V_x \cdot \frac{10}{10 + 10} = 5 \text{ V}$

Short-circuit conditions



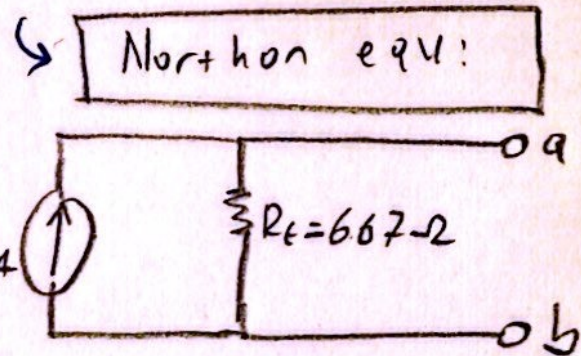
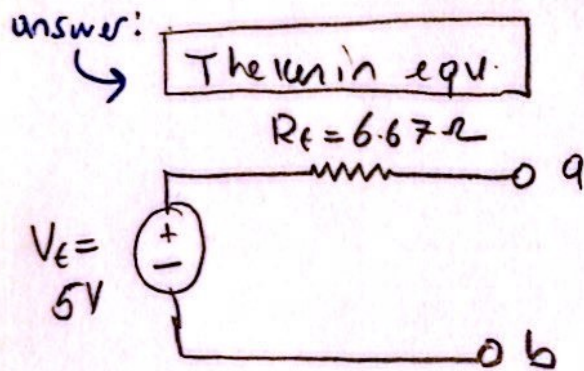
$$i_x = \frac{15 - V_x}{5} \quad \& \quad \frac{V_x}{10} - i_x + 0.5 i_x = 0 \rightarrow \text{solve for } V_x$$

$$V_x = 7.5 \text{ V}$$

$$i_{sc} = \frac{V_x}{10} = 0.75 \text{ A}$$

$$\text{then we have } R_t = \frac{V_{oc}}{i_{sc}} = \boxed{6.67 \Omega}$$

answer:



Q3)

$$\begin{aligned} \text{a) node 1} \quad & \frac{V_1}{20} + \frac{V_1 - V_2}{10} = 1 \\ \text{a) node 2} \quad & \frac{V_2}{5} + \frac{V_2 - V_1}{10} = 2 \end{aligned} \quad \left. \vphantom{\begin{aligned} \text{a) node 1} \\ \text{a) node 2} \end{aligned}} \right\} \Rightarrow \begin{aligned} 0.15V_1 - 0.1V_2 &= 1 \\ -0.1V_1 + 0.3V_2 &= 2 \end{aligned}$$

↓ solve for V_1 & V_2

$$V_1 = 14.29 \text{ V}$$

$$V_2 = 11.43 \text{ V}$$

$$i_1 = \frac{V_1 - V_2}{10} = \boxed{0.2857 \text{ A}}$$

Q4) write KVL eqns around each mesh

$$\begin{aligned} \text{a) left mesh} \quad & 5i_1 + 15(i_1 - i_2) = 20 \\ \text{a) right mesh} \quad & 15(i_2 - i_1) + 10i_2 = 10 \end{aligned} \quad \left. \vphantom{\begin{aligned} \text{a) left mesh} \\ \text{a) right mesh} \end{aligned}} \right\} \Rightarrow \begin{aligned} 20i_1 - 15i_2 &= 20 \\ -15i_1 + 25i_2 &= 10 \end{aligned}$$

↓ solve for i_1 & i_2

$$i_1 = 2.364 \text{ A}$$

$$i_2 = 1.818 \text{ A}$$

$$P = (i_1 - i_2)^2 \cdot 15 = \boxed{4.471 \text{ W}}$$